

# Preventive Maintenance Optimization at Paranal Observatory

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## ABSTRACT

Observatories are important for the evolution of astronomical research. Equally important is their maintainability. Of course, the management of our fixed budget as well as assuring reliability, availability and system efficiency is directly related to the maintainability of this center of observation.

Can we manage this situation and maintain reliability, availability and efficiency? The answer is, yes. There are new maintenance techniques that allow us to deal with these requirements.

PMO, Preventive Maintenance Optimization is one of the new techniques that has recently grown in popularity and it is structured as follows:

- Prepare PMO
- Define System or Equipment according to Reliability Requirements
- Review Existing PM
- Screen Task for Removal
- Optimize Remaining Tasks
- Fill Gaps on PM
- Review Manufacture Recommendations
- Optimize PM Work Order
- Implement Change
- Evaluate Improvement.

The implementation of PMO is a process that will allow the Observatory to increase the efficiency of the Maintenance plans. The results of this new process will not be evident immediately and will be evaluated in the future.

## 1. INTRODUCTION

The maintenance department of LSP observatory, which was the first department of its kind operating at an observatory, has been working through the years in the development of new techniques and strategies to achieve our goals.

This Paper will focus on the development process of our Maintenance strategies and will also briefly present the tools that we are developing in order to reach our goals.

PMO, which is a tool in wide use today, is primarily concerned with finding a proper way to optimize the Maintenance Plans through the maintenance task, by adding or either removing some of tasks. Of course, the results of this optimization will not be immediate, but will become clear in the long term.

## 2. PMO AS PART OF OUR RELIABILITY PROCESS

### Mission of the Group

“Continuous improvement of all maintenance plans to give reliability and availability to all equipment and subsystem of the Observatory”.

PMO is an important part of the Maintenance internal process and during the development of it you can use various tools in order to progress through the different established steps.

### PMO Steps

#### Prepare PMO:

Define systems Reliability requirement

Establish system criticality Ranking

Establish systems availability Ranking

Selection of the equipment and/or system, according to Reliability, criticality and availability.

#### Define System or Equipment according to Reliability Requirements:

Gather information about the related equipment selected.

Classified the information collected.

Established failure Mode

Analyze the information.

Analyze the failures modes of the system.

#### Review Existing PM:

Check every one of the existing tasks of the actual plan.

Check if the above failure modes are covered by the existing task.

#### Screen Task for Removal:

Review all tasks to decide if it is necessary to remove one or more of them.

#### Optimize Remaining Tasks

Optimization of the existing tasks by adding more information or modifying the existing information.

#### Fill Gaps on PM

Recheck each task and confirm that nothing is missing.

#### Review Manufacture Recommendations

Double check manufacture recommendations

#### Optimize PM Work Order

Modify actual PM work order

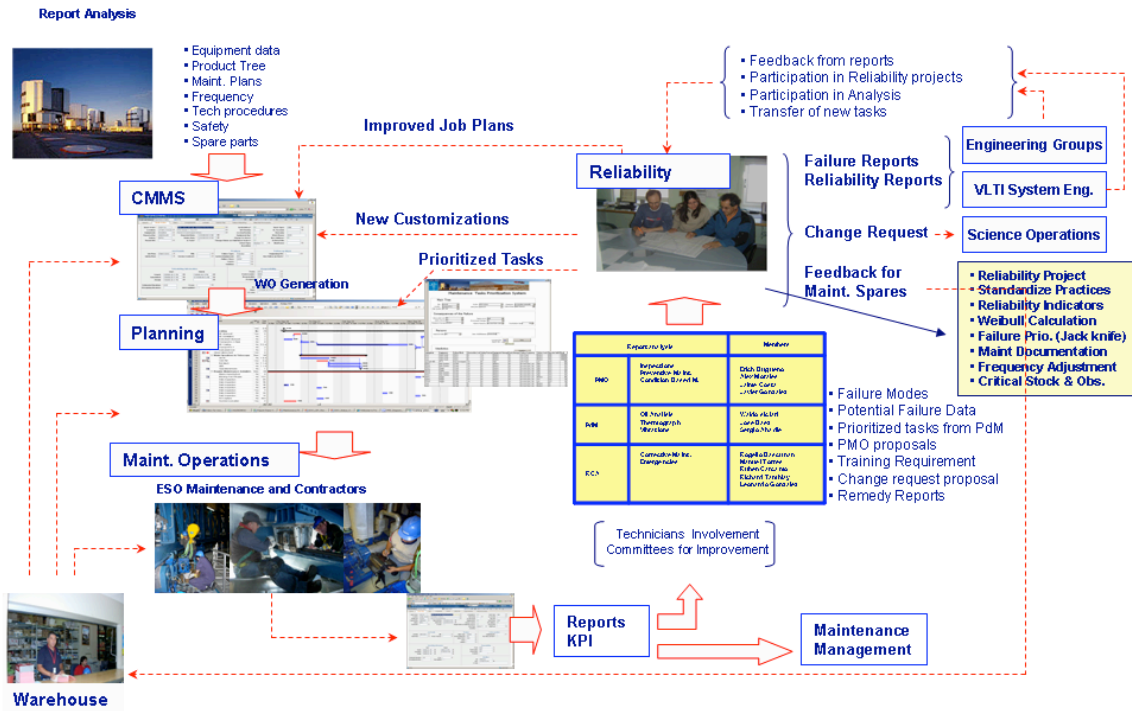
#### Implement Change

Apply all the changes made on site.

#### Evaluate Improvement.

Evaluate all changes with inspections.

# Maintenance Internal Process



## 3. PMO PROCESS AT MAINTENANCE DEPARTMENT OF LA SILLA PARANAL OBSERVATORY

### ■ Prepare For PMO

- Select Equipment or System From the List of Main Systems at the Observatory

System	Sub-system
ENCLOSURE	OBSERVING SLIT DOORS
ENCLOSURE	OBSERVING SLIT DOORS
MAIN STRUCTURE	Ah BRAKE SYSTEM
MAIN STRUCTURE	Ah BRAKE SYSTEM
MAIN STRUCTURE	Ah LOCKING SYSTEMS
ENCLOSURE	WINDSCREENS
ENCLOSURE	WINDSCREENS
MAIN STRUCTURE	HBS
MAIN STRUCTURE	HBS
MAIN STRUCTURE	Az ENCODER
MAIN STRUCTURE	Ah ENCODER
MAIN STRUCTURE	HBS
MI UNIT	Hydraulic System / Support
MI UNIT	M1 Cell
MAIN STRUCTURE	ALTITUD SHUTTERS
MAIN STRUCTURE	CAB E.L07/8 SHUTTER
MI UNIT	EQD Battery
ADAPTER ROTATOR	NASMYTH A ADAP. ROTATOR
ADAPTER ROTATOR	NASMYTH A ADAP. ROTATOR
ADAPTER ROTATOR	NASMYTH A ADAP. ROTATOR
ADAPTER ROTATOR	NASMYTH A ADAP. ROTATOR
ADAPTER ROTATOR	NASMYTH B ADAPROTATOR
ADAPTER ROTATOR	NASMYTH B ADAPROTATOR
ADAPTER ROTATOR	NASMYTH B ADAPROTATOR
ADAPTER ROTATOR	NASMYTH B ADAPROTATOR
ADAPTER ROTATOR	NASMYTH B ADAPROTATOR
ADAPTER ROTATOR	CASSEGRAIN ADAP. ROTATOR
ADAPTER ROTATOR	CASSEGRAIN ADAP. ROTATOR
ADAPTER ROTATOR	CASSEGRAIN ADAP. ROTATOR
ADAPTER ROTATOR	CASSEGRAIN ADAP. ROTATOR

### ■ Define Systems

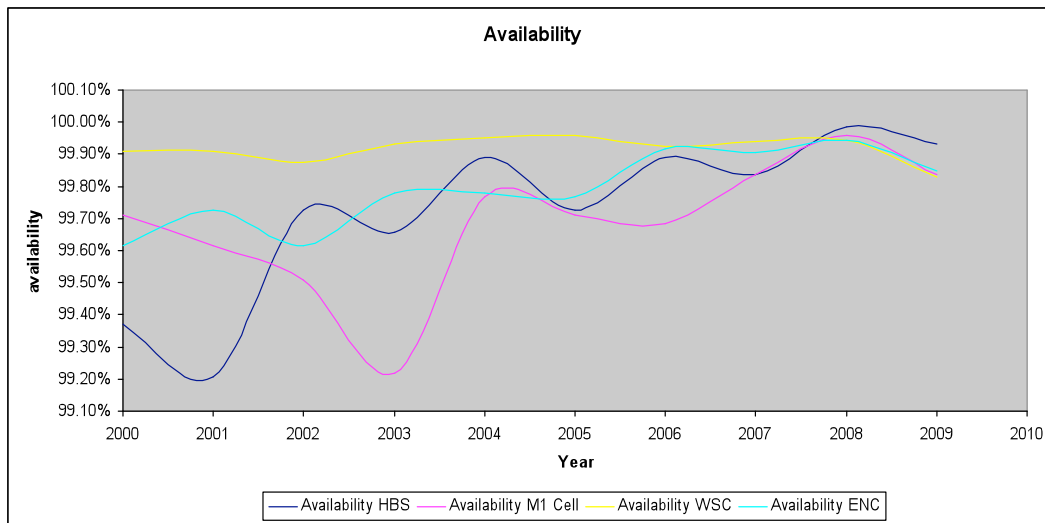
### Reliability Requirements

➤ Establish System Criticality Rankings

System	Sub-system	Jobs	PM	FF	PO	MA	DP	ED	PL	Done by	proposal
ENCLOSURE	OBSERVING SLIT DOORS	PM Mechanical	OSD6M001	2	8	1	10	8	1280	ESO	ESO
ENCLOSURE	OBSERVING SLIT DOORS	PM Electrical	OSD1Y005	2	8	1	10	8	1280	ESO	ESO
MAIN STRUCTURE	AH BRAKE SYSTEM	PM Mechanical	ABR6M001	1	12	1	10	8	960	ESO	ESO
MAIN STRUCTURE	AH BRAKE SYSTEM	PM Electrical		1	12	1	10	8	960	ESO	ESO
MAIN STRUCTURE	AH LOCKING SYSTEMS	PM Mechanical	ALS6M001	1	8	1	10	8	640	ESO	ESO
ENCLOSURE	WINDSCREENS	PM Mechanical	WSC6M001	1	8	1	10	5	400	ESO	ESO
ENCLOSURE	WINDSCREENS	PM Electrical	WSC1Y005	1	8	1	10	5	400	ESO	ESO
MAIN STRUCTURE	HBS	PM Mechanical	HBS6M001	2	12	1	1	5	120	ESO	ESO
MAIN STRUCTURE	HBS	PM Electrical	HBS1Y005	2	12	1	1	5	120	ESO	ESO
MAIN STRUCTURE	Az ENCODER	PM Electrical	ZEN1M001	1	12	1	1	8	96	ESO	ESO
MAIN STRUCTURE	Ah ENCODER	PM Electrical	AEN1M001	1	12	1	1	8	96	ESO	ESO
MAIN STRUCTURE	HBS	Test HBS		4	4	1	1	5	80	ESO	ESO
M1 UNIT	Hydraulic System / Support	IN Mechanical		2	4	1	1	8	64	ESO	ESO
M1 UNIT	M1 Cell	PM Mechanical		1	8	1	1	8	64	ESO	ESO
MAIN STRUCTURE	ALTITUD SHUTTERS	PM Mechanical	ASH1M001	1	8	1	1	8	64	ESO	ESO
MAIN STRUCTURE	CAB E.L07/8 SHUTTER	PM Electrical	ASH1Y005	1	8	1	1	8	64	ESO	ESO
M1 UNIT	EQD Battery	PM Electrical		1	8	1	1	8	64	ESO	ESO
ADAPTER ROTATOR	NASMYTH A ADAP. ROTATOR	PD Test Torque Adapter	ART6M001	1	12	1	1	5	60	ESO	ESO
ADAPTER ROTATOR	NASMYTH A ADAP. ROTATOR	PD Encoder Test Adapter	ART6M025	1	12	1	1	5	60	ESO	ESO
ADAPTER ROTATOR	NASMYTH A ADAP. ROTATOR	PD Test Torque Rotator	ART6M013	1	12	1	1	5	60	ESO	ESO
ADAPTER ROTATOR	NASMYTH A ADAP. ROTATOR	PD Encoder Test Rotator	ART6M037	1	12	1	1	5	60	ESO	ESO
ADAPTER ROTATOR	NASMYTH B ADAPROTATOR	PD Test Torque Adapter	ART6M002	1	12	1	1	5	60	ESO	ESO
ADAPTER ROTATOR	NASMYTH B ADAPROTATOR	PD Encoder Test Adapter	ART6M026	1	12	1	1	5	60	ESO	ESO
ADAPTER ROTATOR	NASMYTH B ADAPROTATOR	PD Test Torque Rotator	ART6M014	1	12	1	1	5	60	ESO	ESO
ADAPTER ROTATOR	NASMYTH B ADAPROTATOR	PD Encoder Test Rotator	ART6M038	1	12	1	1	5	60	ESO	ESO
ADAPTER ROTATOR	CASSEGRAIN ADAP. ROTATOR	PD Test Torque Adapter	ART6M009	1	12	1	1	5	60	ESO	ESO
ADAPTER ROTATOR	CASSEGRAIN ADAP. ROTATOR	PD Encoder Test Adapter	ART6M027	1	12	1	1	5	60	ESO	ESO
ADAPTER ROTATOR	CASSEGRAIN ADAP. ROTATOR	PD Test Torque Rotator	ART6M021	1	12	1	1	5	60	ESO	ESO
ADAPTER ROTATOR	CASSEGRAIN ADAP. ROTATOR	PD Encoder Test Rotator	ART6M039	1	12	1	1	5	60	ESO	ESO
MAIN STRUCTURE	AH DRIVE SYSTEM	PM Mechanical	ADR6M001	1	12	1	1	5	60	ESO	ESO
MAIN STRUCTURE	AH DRIVE SYSTEM	PM Electrical	ADR1Y005	1	12	1	1	5	60	ESO	ESO
ENCLOSURE	CAB E.E02	PM Electrical	CAB1Y019	1	8	1	1	5	40	ESO	ESO
ENCLOSURE	CAB E.H01 MMD/VDS/RTM/ATU	PM Electrical	CAB1Y013	1	8	1	1	5	40	ESO	ESO
ENCLOSURE	CAB E.H03 LVR/OSD/Locking Pin	PM Electrical	CAB1Y001	1	8	1	1	5	40	ESO	ESO
ENCLOSURE	CAB E.L02 LVR / WSC	PM Electrical	CAB1Y005	1	8	1	1	5	40	ESO	ESO
ENCLOSURE	CAB E.L03 LVR / OSD	PM Electrical	CAB1Y009	1	8	1	1	5	40	ESO	ESO

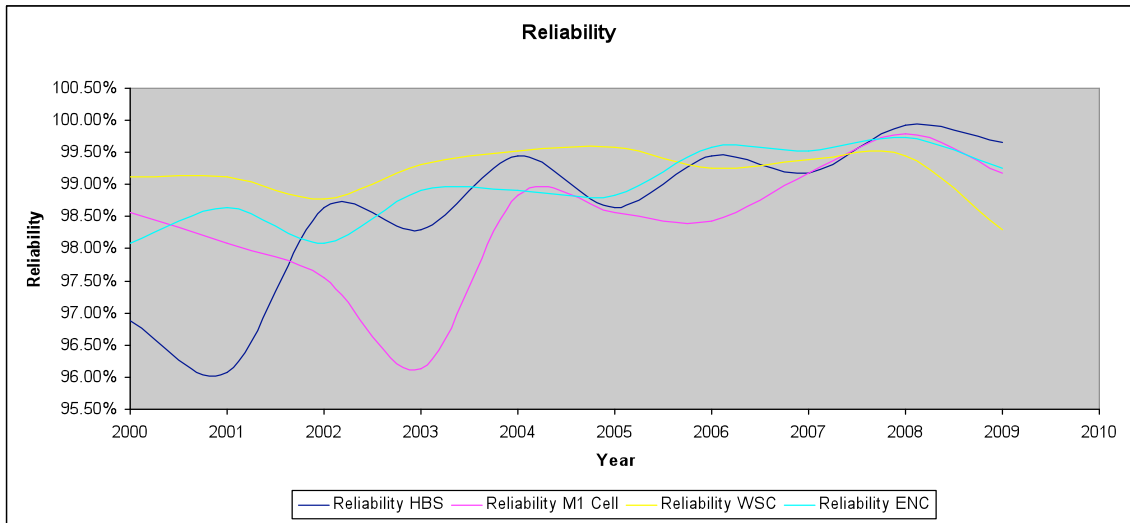
■ Define Systems Reliability Requirements

➤ Establish System Availability Rankings



■ Define Systems Reliability Requirements

➤ Establish System Reliability Rankings



■ Define Systems Reliability Requirements

➤ Selection of the System to be Analyzed

According to the criticality and reliability analysis we came to the conclusion that the System that most requires Optimization is the **Wind Screen System**



■ Define Systems Reliability Requirements

➤ Failure Modes, Causes & Effects

For this Purpose we gather information from two Sources of data:

- PPRS Action Request System
- CCMS Data base MAXIMO

■ Define Systems Reliability Requirements

➤ Failure Modes, Causes & Effects

First : PPRS Action Request System

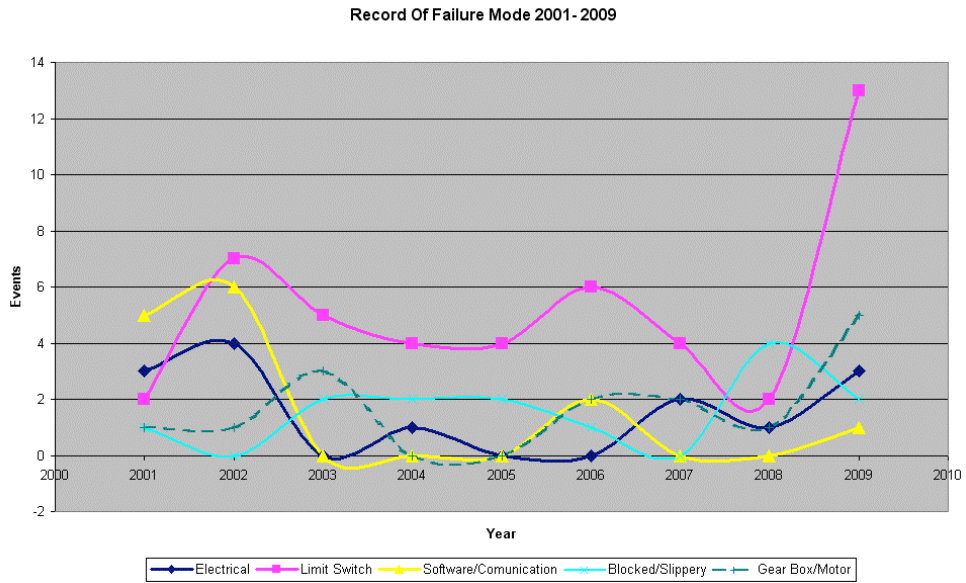
2001	PPRS-003983	Melipal (UT3)	Software/Communication	WS Syst.	Software Adjustment
2001	PPRS-004002	Melipal (UT3)	Software/Communication	WS Syst.	Software Adjustment
2001	PPRS-004005	Melipal (UT3)	Software/Communication	WS Syst.	Software Adjustment
2001	PPRS-004313	Melipal (UT3)	Electrical	WS 8 Stuck	Reset syst.
2001	PPRS-004424	Melipal (UT3)	Software/Communication	WS 16 Stuck	Reset syst.
2001	PPRS-004435	Melipal (UT3)	Electrical	WS 8 Stuck	Loose Wire J-Box
2001	PPRS-004437	Melipal (UT3)	Limit Switch	WS 8 Stuck	Adjust Limit Switch
2001	PPRS-004493	Yepun (UT4)	Limit Switch	WS 26 Stuck	Re-tie bolts of Limit S.
2001	PPRS-004635	Yepun (UT4)	Gear Box/Motor	WS 6 Stuck	Belt adjustment
2001	PPRS-004669	Yepun (UT4)	Software/Communication	WS Syst.	Set Auto High
2001	PPRS-004894	Melipal (UT3)	Blocked/Slippery	WS 24 Stuck	Mechanical Adjustment
2001	PPRS-005735	Antu (UT1)	Electrical	WS14	Circuit Braker reset
2001	PPRS-005742	Antu (UT1)	Electrical	WS14	Reset
2009	PPRS-029989	Kueyen (UT2)	Blocked/Slippery	WS-22 disaligned, noisy	Mechanical Adjustment
2009	PPRS-030144	Melipal (UT3)	Limit Switch	WS-13 Stuck	Adjust Limit Switch
2009	PPRS-030231	Yepun (UT4)	Blocked/Slippery	WS-23 Stuck	Run Several Times
2009	PPRS-030260	Melipal (UT3)	Limit Switch	WS-13 Stuck	Adjust Limit Switch
2009	PPRS-030539	Antu (UT1)	Electrical	WS Syst	Replace PLC
2009	PPRS-030588	Antu (UT1)	Limit Switch	WS26	Alignment
2009	PPRS-030637	Yepun (UT4)	Electrical	WS-23 Stuck	Thermal Protection
2009	PPRS-030694	Yepun (UT4)	Gear Box/Motor	WS-23 Stuck	Alignment of Motor
2009	PPRS-030700	Kueyen (UT2)	Gear Box/Motor	Oil leak	Replace Seal
2009	PPRS-030857	Yepun (UT4)	Limit Switch	WS-23 Stuck	Replace Limit Switch
2009	PPRS-030912	Melipal (UT3)	Limit Switch	WS 6 Faulty State	Replace Limit Switch
2009	PPRS-031228	Yepun (UT4)	Electrical	WS-23 Stuck	Loose Cable at J-Box
2009	PPRS-031633	Melipal (UT3)	Gear Box/Motor	WS-20 Stuck	Replace Gear Box
2009	PPRS-031741	Yepun (UT4)	Gear Box/Motor	WS-26 Stuck	Gear Box Belt
2009	PPRS-031747	Melipal (UT3)	Limit Switch	WS-17 Faulty State	Adjust Limit Switch
2009	PPRS-031811	Yepun (UT4)	Limit Switch	WS-26 Stuck	Adjust Limit Switch
2009	PPRS-031859	Yepun (UT4)	Limit Switch	WS-26 Stuck	Lubricate Limit Switch
2009	PPRS-032083	Kueyen (UT2)	Limit Switch	WS-26 did not operate	Adjustment Limit Switch
2009	PPRS-032214	Yepun (UT4)	Limit Switch	WS-26 Stuck	Replace Limit Switch
2009	PPRS-032228	Yepun (UT4)	Limit Switch	WS-5 Stuck	Lubricate Limit Switch
2009	PPRS-032851	Yepun (UT4)	Software/Communication	WS-2 Stuck	Up date
2009	PPRS-032886	Kueyen (UT2)	Limit Switch	WS-20 did not operate	Lubricate Limit Switch
2009	PPRS-033151	Yepun (UT4)	Gear Box/Motor	WS-3 Stuck	Alignment of Motor

■ Define Systems Reliability Requirements

➤ Failure Modes, Causes & Effects

**First** : PPRS Action Request System

As results of the classification of the PPRS information, we obtain the following results

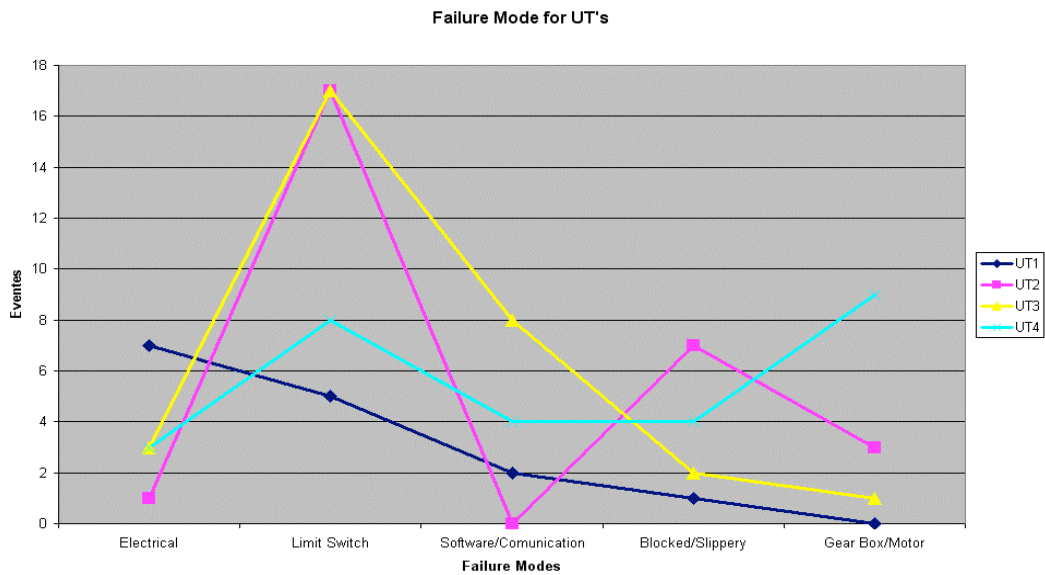


■ **Define Systems Reliability Requirements**

➤ Failure Modes, Causes & Effects

**First** : PPRS Action Request System

Also the analysis was done for each Telescope.

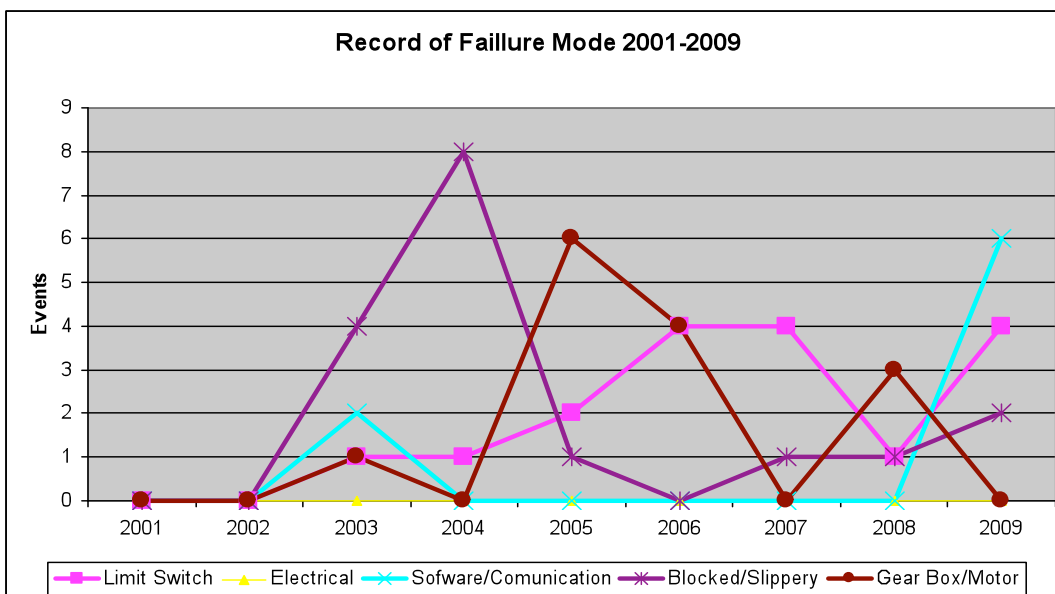


Define Systems Reliability Requirements  
 Failure Modes, Causes & Effects  
 Second : CCMS Data base MAXIMO

Microsoft Excel - Reliability analysis WSC via Maximo Oct 29, 2015

VO	Date	Keywords	Worksta	Structure	Sub System	Equipment	Failure Mode	Cause	Solution	Failure Type	System Component	Maintenance Type	
10196	23/05/2003	CM - UT3 - WSC - Check WindScreen 9 and 10	1	Enclosure	WSC 3	WSC	Maintenance	Non		Potential	Fan	CM	
10485	20/06/2003	CM - UT4 - WSC - Replace Disc Embrages Gearbox	3	Enclosure	WSC 12	Gearbox	Clutch disk	Breaking	Replace	Fanatical	Fanatical	CM	
10410	03/07/2003	CM - UT4 - WSC - Check oil level column #1	6	Enclosure	WSC 17	Gearbox	Misalignment	Loose bolt	Tighten	Fanatical	Fanatical	CM	
11271	05	26/08/2003	CM - UT1 - WSC - Failure in Windscreen Number 14	15	Enclosure	WSC 14	Electrical motor	Limit Switch	Misalignment	Replace	Fanatical	CM	
13298	3	23/12/2003	CM - UT2 - WSC - Flip Change #16	6	Enclosure	WSC 16	Flap	Fixation System	Damage	Replace	Fanatical	CM	
13328	3	23/12/2003	CM - UT2 - WSC - Flip Change #21	6	Enclosure	WSC 21	Flap	Fixation System	Damage	Replace	Fanatical	CM	
13600	3	30/12/2003	CM - UT4 - WSC - Flip Change #3	6	Enclosure	WSC 3	Flap	Fixation System	Damage	Replace	Fanatical	CM	
14145	3	30/02/2004	CM - UT1 - WSC - Change Flap of line #9 Right	6	Enclosure	WSC 9	Flap	Fixation System	Damage	Replace	Fanatical	CM	
15192	0	26/04/2004	CM - UT2 - WSC - Change roller see 2	0	Enclosure	WSC 2	Roller	Fixation System	Damage	Replace	Fanatical	CM	
16600	3	31/05/2004	CM - UT3 - WSC 5 - Change Flap Right	6	Enclosure	WSC 5	Flap	Fixation System	Damage	Replace	Fanatical	CM	
18201	00	21/07/2004	CM - UT3 - WSC - Repair Column number 3	15	Enclosure	WSC 3	Roller	Fixation System	Damage	Replace	Fanatical	CM	
18202	05	02/05/2004	CM - UT2 - WSC - Repair Column number 3	17	Enclosure	WSC 3	Roller	Misalignment	Brush	Replace	Fanatical	CM	
18253	3	05/03/2004	CM - UT1 - WSC - Change Flap of line #14 Left	6	Enclosure	WSC 14	Flap	Fixation System	Damage	Replace	Fanatical	CM	
19033	15	10/03/2004	CM - UT3 - WSC - Change Limit Switch Head	3	Enclosure	WSC 2	Transmission	Limit Switch	Stuck	Replace	Fanatical	CM	
19580	2	13/10/2004	CM - UT4 - WSC - Flip Change #12 Left	4	Enclosure	WSC 12	Flap	Ribbit	Damage	Replace	Fanatical	CM	
19589	25	13/10/2004	CM - UT4 - WSC - Flip Change # 05 Left	5	Enclosure	WSC 5	Flap	Ribbit	Damage	Replace	Fanatical	CM	
20169	2	03/11/2004	CM - UT4 - WSC - Flip Change # 3 Right	4	Enclosure	WSC 3	Flap	Maintenance	Non	Replace	Fanatical	CM	
21314	25	27/12/2004	CM - UT4 - WSC 22 - Replace FLAP Left	4,0	Enclosure	WSC 22	Flap	Maintenance	Non	Replace	Fanatical	CM	
22360	15	26/06/2005	CM - UT2 - WSC Check	5,5	Enclosure	WSC 3	Gearbox	Clutch	Loose bolt	Tighten	Fanatical	CM	
24311	15	25/07/2005	EM - UT2 - WSC - Replace the brake disc WSC 24	15	Enclosure	WSC 24	Gearbox	Disc brake	Damage	Replace	Fanatical	CM	
24344	1	26/07/2005	CEM - UT1 - WSC - Check and change disk brake	1	Enclosure	WSC	Gearbox	Disc brake	Damage	Replace	Fanatical	CM	
24347	1	26/07/2005	CEM - UT3 - WSC - Check and change disk brake	3,5	Enclosure	WSC 13	Gearbox	Disc brake	Damage	Replace	Fanatical	CM	
24348	1	26/07/2005	CEM - UT3 - WSC - Check and change disk brake	1	Enclosure	WSC	Gearbox	Oil leak	Non	Replace	Fanatical	CEM	
24349	1	26/07/2005	CEM - UT4 - WSC - Check and change disk brake	1	Enclosure	WSC	Gearbox	Oil leak	Non	Replace	Fanatical	CEM	
248130	1	27/06/2005	CEM - UT2 - WSC #11 - Repair Guide	6	Enclosure	WSC 11	Roller	Loose Guide	Damage bolt	Adjustment	Fanatical	EM	
248131	15	28/08/2005	EM - UT2 - WSC #24 - Repair Guide	15	Enclosure	WSC 24	Transmission	Limit Switch	Cut belt	Replace	Fanatical	EM	
2481450	15	25/12/2005	CEM - UT3 - WSC - Check	1	Enclosure	WSC 2	Transmission	Limit Switch	Activated	Deactivated	Fanatical	EM	
251	1	14/04/2006	CM - UT2 - WSC 15 - Limit	1	Enclosure	WSC 15	Transmission	Limit Switch	Non	Replace	Fanatical	CM	
3051805	3,5	30/05/2006	CM - UT2 - Enclosure WSC 17 Check belt and check unit gear box and motor	10,5	Enclosure	WSC 17	Electrical motor	Belt	Cut belt	Replace	Fanatical	CM	
3258224	2	07/08/2006	CM - UT3 - WSC - Repair Column #1	2	Enclosure	WSC 11	Transmission	Limit Switch	Noise	Adjustment	Fanatical	CM	
3258222	1	07/08/2006	CM - UT4 - WSC - Repair Column 7	1	Enclosure	WSC 7	Transmission	Limit Switch	Noise	Adjustment	Fanatical	CM	
3409161	1	03/10/2006	CM - UT1 - WSC - Bw # 16 does not ruzgued (limit switch)	2	Enclosure	WSC 16	Transmission	Limit Switch	Non	Adjustment	Fanatical	CM	
3430001	1	13/10/2006	CEM - UT3 - WSC #3 - In set work	7	Enclosure	WSC 3	Electrical motor	Belt	Cut belt	Replace	Fanatical	CM	
3577246	3	12/12/2006	CEM - UT4 - WSC 24 - Change Gearbox GBX1153	3	Enclosure	WSC 24	Gearbox	Maintenance	Non	Replace	Fanatical	CEM	
3577248	18	12/12/2006	CEM - UT4 - WSC 18 - Change Gearbox GBX1187	15	Enclosure	WSC 18	Gearbox	Maintenance	Non	Replace	Potential	CEM	
3577250	3,5	12/12/2006	CEM - UT4 - WSC 19 - Change Gearbox GBX1188	3,5	Enclosure	WSC 19	Gearbox	Maintenance	Non	Replace	Potential	CEM	
3578103	3	12/12/2006	CEM - UT4 - WSC 20 - Change Gearbox GBX1189	3	Enclosure	WSC 20	Gearbox	Oil leak	Non	Replace	Potential	CEM	
3578105	3	12/12/2006	CEM - UT4 - WSC 21 - Change Gearbox GBX1190	3	Enclosure	WSC 21	Gearbox	Oil leak	Non	Replace	Potential	CEM	
3578107	3	12/12/2006	CEM - UT4 - WSC 23 - Change Gearbox GBX1192	3	Enclosure	WSC 23	Gearbox	Maintenance	Non	Replace	Potential	CEM	
3578109	3	12/12/2006	CEM - UT4 - WSC 26 - Change Gearbox GBX1195	3	Enclosure	WSC 26	Gearbox	Maintenance	Non	Replace	Potential	CEM	
3578113	3	12/12/2006	CEM - UT4 - WSC 07 - Change Gearbox GBX1196	3	Enclosure	WSC 7	Gearbox	Maintenance	Non	Replace	Potential	CEM	
3605521	1	21/01/2007	EM - UT4 - WSC 13 - Repair Transmission belt	1	Enclosure	WSC 13	Transmission	Limit Switch	Non	Replace	Potential	EM	
3605581	2	21/01/2007	CEM - UT4 - WSC 17 - Change Gearbox GBX1185	2	Enclosure	WSC 17	Gearbox	Maintenance	Non	Replace	Potential	CEM	
3605582	2	24/02/2007	CEM - UT4 - WSC 15 - Change Gearbox GBX1184	2	Enclosure	WSC 15	Gearbox	Maintenance	Non	Replace	Potential	CEM	
3605640	2	24/02/2007	CEM - UT4 - WSC 16 - Change Gearbox GBX1185	2	Enclosure	WSC 16	Gearbox	Maintenance	Non	Replace	Potential	CEM	
3794502	2,5	04/03/2007	CEM - UT4 - WSC 14 - Change Gearbox GBX1183	2,5	Enclosure	WSC 14	Gearbox	Maintenance	Non	Replace	Potential	CEM	
3808227	2,5	20/04/2007	CEM - UT4 - WSC 07 - Maintenance Motor MOT1284	5	Enclosure	WSC 7	Transmission	Limit Switch	Misalignment	Replace	Potential	Potential	
3903407	1	10/05/2007	CM - UT2 - Enclosure WSC 21 - Limit Switch Change	1	Enclosure	WSC 21	Transmission	Limit Switch	Undetermined	Replace	Fanatical	CM	
4211511	0,5	15/12/2007	BD - UT3 - WSC - Repair see 18	1	Enclosure	WSC 18	Transmission	Limit Switch	Activated	Deactivated	Fanatical	BD	
441758	2,5	26/12/2007	CM - UT3 - Change of head limit Wind screen	5	Enclosure	WSC	Transmission	Stuck	Limit Switch	Replace	Fanatical	CM	
453751	3,5	30/04/2008	CEM - UT3 Windscreen Close up all windscreen and near by wsc3	3,5	Enclosure	WSC	WSC	Maintenance	Non	Replace	Non	CM	
4600147	5	30/05/2008	CEM - UT2 - Windscreen # 14, get stuck	6,5	Enclosure	WSC 14	WSC	Stuck	Non	Adjustment	Fanatical	CM	
4854310	5	30/05/2008	CM - UT2 - WSC - Problem in transmission wsc #14	5	Enclosure	WSC 14	Transmission	Belt	Non	Replace	Fanatical	CM	
4854310	1	02/10/2008	CEM - UT4 - WSC - Repair Gearbox GBX1190	1	Enclosure	WSC 1	Gearbox	Maintenance	Non	Replace	Potential	CEM	
4854322	1	03/10/2008	EM - UT2 - WSC - Repair Limitswitch WSC # 17	1	Enclosure	WSC 17	Transmission	Limit Switch	Activated	Deactivated	Fanatical	EM	
4854322	15	17/10/2008	EM - UT4 - WSC 20 - Problem in gear box	4,5	Enclosure	WSC 20	Gearbox	Oil leak	Non	Replace	Fanatical	EM	
4854324	16	13/11/2008	CEM - UT2 - WSC - Replace the belts	16	Enclosure	WSC 16	Gearbox	Electrical motor	Oil leak	Non	Replace	Fanatical	CEM
4854381	2,5	20/11/2008	CEM - UT3 - WSC #18 - Repair Gearbox GBX1035	16	Enclosure	WSC 18	Gearbox	Maintenance	Non	Replace	Potential	CEM	
4854383	2,5	20/11/2008	CEM - UT3 - WSC #19 - Repair Gearbox GBX1036	2,5	Enclosure	WSC 19	Gearbox	Maintenance	Non	Replace	Potential	CEM	

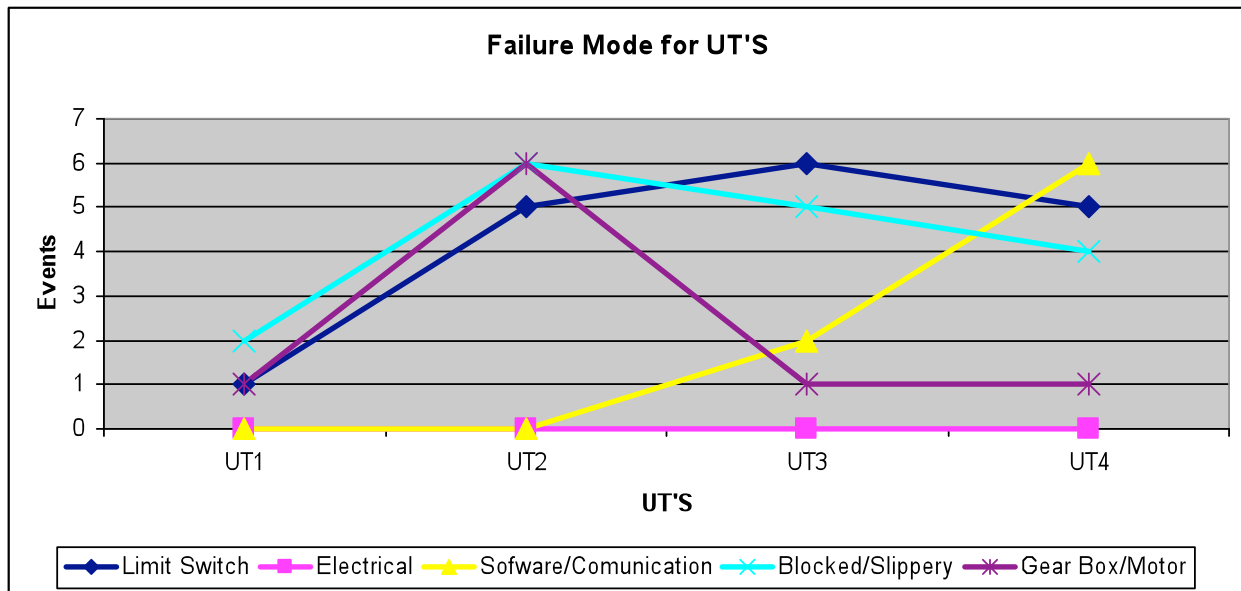
Define Systems Reliability Requirements  
 Failure Modes, Causes & Effects  
 Second: CCMS Data base MAXIMO





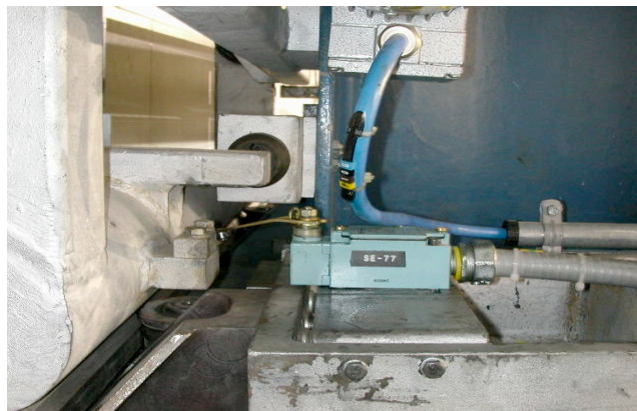
## ■ Define Systems Reliability Requirements

- Failure Modes, Causes & Effects
- Second:** CCMS Data base MAXIMO



## □ Summary

- As seen on the previous statistical graphics, the Limit Switch and the Gear Box have the most frequent failure events



## ■ Review Existing PM

- PM - Mech - 6M - Enc - WSC
- PM - Mech - 1Y - Enc - WSC
- PM - Elec - 1Y - Enc - WSC Electrical

#### ■ **Screen Task for Removal**

- Screen Task steps
  - Check all the activities of the PM
  - Double check the existing activities
  - Make proposal for removing activities.

#### ■ **Optimize Remaining Tasks**

- Optimize Remaining Tasks
  - Optimize remaining tasks by adding actions that will meet the requirements of the new tasks.
  - Discuss the implementation of the tasks with the PMO board.
  - Make all necessary arrangements to update PM.

#### ■ **Fill Gaps on PM.**

- Fill Gaps on PM
  - Check PM plan several times as well as any task that may not be cover by the new plan
  - Propose modification if necessary

#### ■ **Review OEM Recommendations**

- Review all maintenance activities suggested by the manufacturer.
  - Check PM plan proposed by manufacturer.
  - Propose modifications if necessary
  - Update new maintenance plan

#### ■ **Optimize PM Work Order.**

- Proceed with the optimization of the new plan
  - Update new list of activities
  - Double check the new list to ensure that nothing is missing.

#### ■ **Implement Change.**

- On site Implementation of changes
  - During the following PM activities, proceed with the implementations

#### ■ **Evaluation of the Improvement.**

- The evaluation of all improvements will require several months or monitoring to obtain reasonable statistics.
  - Three months after task implementation, assess effect of changes.
  - Performing statistics graphics of the new behavior of the WS will give a clear idea of the effect of the implemented action.

## 4. CONCLUSIONS

- The implementation of this new tool in conjunction with other pre-existing techniques will contribute to maintaining the reliability, availability and efficiency of the Wind Screen System.
- The Reliability group will suggest other PMs that could benefit from similar Optimization.
- The continuous improvement of the existing Maintenance Plan will contribute to increase the Reliability of all others systems in the UT's.

## 5. REFERENCES

- <http://www.reliabilityu.com/>
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- Gonzalez, C. "Maintenance Cost Optimization Program, Summer Student of Maintenance Department at La Silla Paranal Observatory.